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Effective Design of an Agribot for Smart Farming

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Abstract

The classical agricultural activities require huge manual efforts and excursions on field which can be replaced using automation or smart farming based devices. Agribot is the excellent example of computerized or smart implementation of the agricultural devices which can work in autonomous mode with live monitoring from a remote location. Agriculture is the need of most of the Indians livelihood and it is one of the main sources of livelihood. It also has a major impact on economy of the country. We know there is day by day increase in population. Due to this tremendous growth in population there is huge demand or food. Agriculture is the main source for food production. So, we need to develop the methodologies which are currently uses in agriculture application to increase the efficiency of application. Due to this reason we are going to prepare "multipurpose agriculture Robot" which present four applications are like Grass cutter, Ploughing, Seed sower, Sprinkler. These applications make sure that the time required for it is less than conventional methods. We prefer robot for carried out these applications because robot is a mechanical, artificial agent and is usually an electromechanical (Mechatronics) system. By using controller we operate whole robot by wireless remote. In that remote we have four buttons for forward reverse motion and one switch for operating sprinkler and grass cutter mechanism. For ploughing mechanism we are going to use hydraulic jack and for sprinkler high pressure liquid is provided with the help

of pump. If we use this robot in real time application it save money and time consumption. With this help of robot we can achieve human safety at the night time and we easily perform task which is in complicated location.

Keywords - Agbot, Agribot, Agricultural Robot, Smart Agriculture, Automated Agriculture, Smart Farming

Introduction

Now days, the usage of smart gadgets and programmed devices are prevalent in almost every domain to replace or reduce the human

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efforts and time. Agriculture is one of the key domains where huge human efforts are required in multiple areas including

- Weed Control
- Seeding
- Planting
- Ploughing
- Harvesting
- Soil Analytics
- Horticulture
- Environmental Monitoring
- Picking and Fetching
- Sheep Shearing
- Livestock Applications
    - and many others

Figure 1: Agribots in the Smart Agricultural Operations

Agriculture Robots or Agribots, sometimes called as Agbots makes use of technology based mechanical engineering with the automation process to implement the farming activities [1]. Now days, such automated devices are implemented in the farms so that the overall process of farming can be effectually implemented without human intervention and higher degree of productivity and accuracy [2]. The key advantages of using agribot includes protection of the crops against harmful and disastrous effects from the chemicals, environment friendly smart farming, dynamic smart spraying, dog-walk mode in different regions of land, automatic refueling, transversal movement, multiple agronomic tasks concurrently, adjustable caterpillar spacing, on-the-spot turning mode and many others. These agribots can assist in the assorted domains and fields of agriculture lands including orchards, vineyards, plantations, olive groves, vegetables and so many related perspectives.

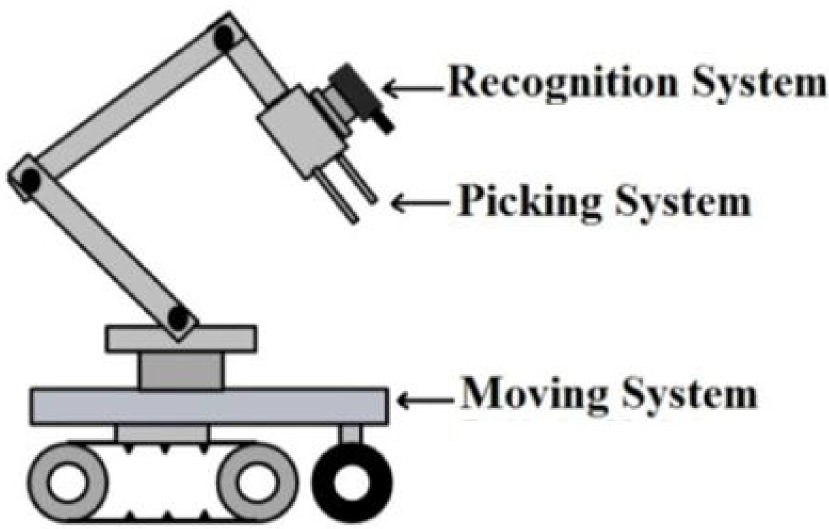


Figure 2: Classical Functions and Operations in the Agribot

The effectual design of an agribot consist of the multiple components including Gripper, Manipulator and End-Effector [3].

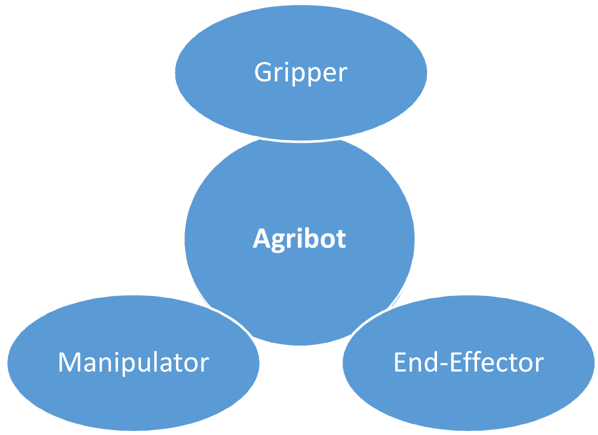


Figure 3: Components of the Agribot

Manipulator : Manipulator is used to assist the end-effector as well as gripper in the process of navigation in the field. It is traditionally having parallel links to maintain the position and height of the gripper.

Gripper : Gripper is used as a grasping or holding device in the harvesting process associated with the crops. The design and implementation aspects of gripper is quite simple and cost effective. It integrates a sharp blade for the operations associated with cutting and further holding.

End-Effector : The end-effector is the device that is placed at the end or tail-point of the robotic arm in the agricultural robot. It is used and integrated for multiple agricultural tasks, purposes and operations including cutting, pushing, spraying, grasping and similar functions.

Examples of Agribots in assorted domains

- Vinobot
- Vinoculer
- Strawberry picking Agrobot.
- Casmobot slope mower
- Fieldrobot Event is a competition in mobile agricultural robotics
- HortiBot - A Plant Nursing Robot,
- Lettuce Bot for Thinning of Lettuce and Organic Weed Elimination
- Japanese Rice planting Agribot
- IBEX weed spraying robot
- Extreme terrain functioning Agribot
- FarmBot
- Open Source CNC Farming

- Australian Centre for Field Robotics (ACFR)
- Autonomous mapping
- Phenotyping
- CNC Weeding for crops
- Real time Livestock monitoring.

Review of Literature

1. "Robotic Agriculture Machine", Gholap Dipak Dattatraya, More Vaibhav Mhatardev, Lokhande Manojkumar Shrihari, Prof. Joshi BE [E&TC], Vishwabharati Academy's College Of Engineering, Pune university, Ahmednagar, Maharashtra. This paper presents a system with high speed of operation for an advanced agriculture process which includes cultivation based on robotic platform.

2. "Seed Sowing and Sprinkling Using Robotics Technology", Swati D.Sambare, S.S.Belsare Dept. of Electronics BVDU COEP Pune, India, The agricultural system in India should be advanced to reduce the efforts of farmers. Various numbers of operations are performed in the agriculture field like seed sowing, weeding, cutting, and pesticide spraying

3. "Design and Implementation of seeding and ploughing agricultural robot.", P.Usha,V.Maheswari, Dr.V.Nandagopal ME Student (Embedded System),2Assitant Professor, 3Associate Professor, 1,2,3 Department of Electrical and Electronics Engineering Ganadipathy Tulsi's Jain Engineering College, Vellore-632 102. ;[Volume No.1, Issue No.1. Page No: 138 - 143, JULY – 2015], In this paper, the robot system is used to develop the process of cultivating agricultural land without the use of man power. The aim of the paper is to reduce the man power, time and increase the productivity rate.

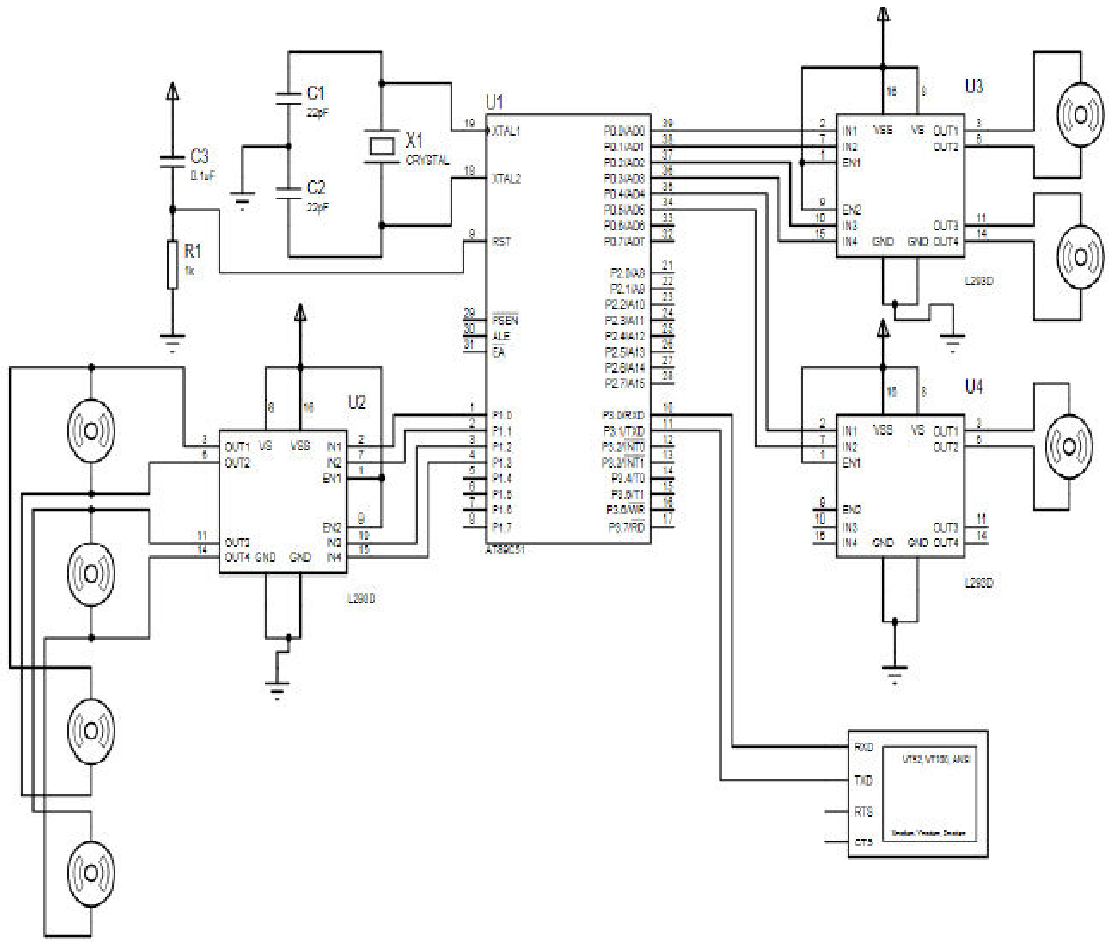
4. "Agricultural Robot for Automatic Ploughing and Seeding", Amrita Sneha, Abirami, Ankita, Mrs.R.Praveena, Mrs.R.Srimeena, Department of Electronics and Instrumentation Engineering Easwari Engineering College, Chennai, Tamil Nadu, India. 2015 IEEE International Conference on Technological Innovations in ICT for Agriculture and Rural Development (TIAR 2015), 978-1-4799-7758-1/15. This paper strives to develop a robot capable of performing operations like automatic ploughing, seed dispensing, fruit picking and pesticide spraying.

Other Related Works

A number of researchers and practitioners have worked on the analysis of similar domain with the suggestive remarks but there is huge scope for the improvement in cases where the deep evaluation of the tools, technologies and paradigms are required to be done. Enormous multi-sources based manuscripts, research papers and articles are analyzed from the time span up to year 2018 so that the latest trends in agribot technology can be evaluated with the following excerpts.

Author(s)	Year	Key Points of the Research Work
Roldán JJ et al. [4]	2018	Presentation of the assorted application domains and recent states of developments in the agricultural robots. The practical experiences are underlined with the specific cases of crop inspection, outdoor agriculture and environment monitoring using agribots.
Pavan, T. V. et al. [5]	2017	The analysis of agribots in different applications of agricultural activities is presented with the particular analysis of seeding. The development with the effectual design of an agribot for seeding activities is presented in this work.
Sampoornam KP. [6]	2017	The work underlines the applications of agribots for the harvesting of underground plants.
Math RK et al. [7]	2017	The work presents the use of wireless networks based agribots with the secured protocols so that the processes of smart farming can be done effectually. The work proposes the use of XBee protocol that is having the base of ZigBee technology so that the live monitoring using agribots can be done using wireless technologies
Khandelwal S. et al. [8]	2017	The manuscript presents the integration of Autonomous Robot or AgRo-Bot for the agricultural activities in which a tri-wheel based agribot is monitored and controlled using ATMEGA328 microcontroller. The association of humidity and temperature sensors is presented in the work for irrigation, water supply and overall monitoring of environmental parameters.

Design Perspectives



Following diagram is circuit diagram of wheel drive. Agribot have four wheels so we connected separate four motors to four wheels with same specification. Out of four motors two motors connected to L293D driver IC and remaining two are connected to other L293D driver IC.

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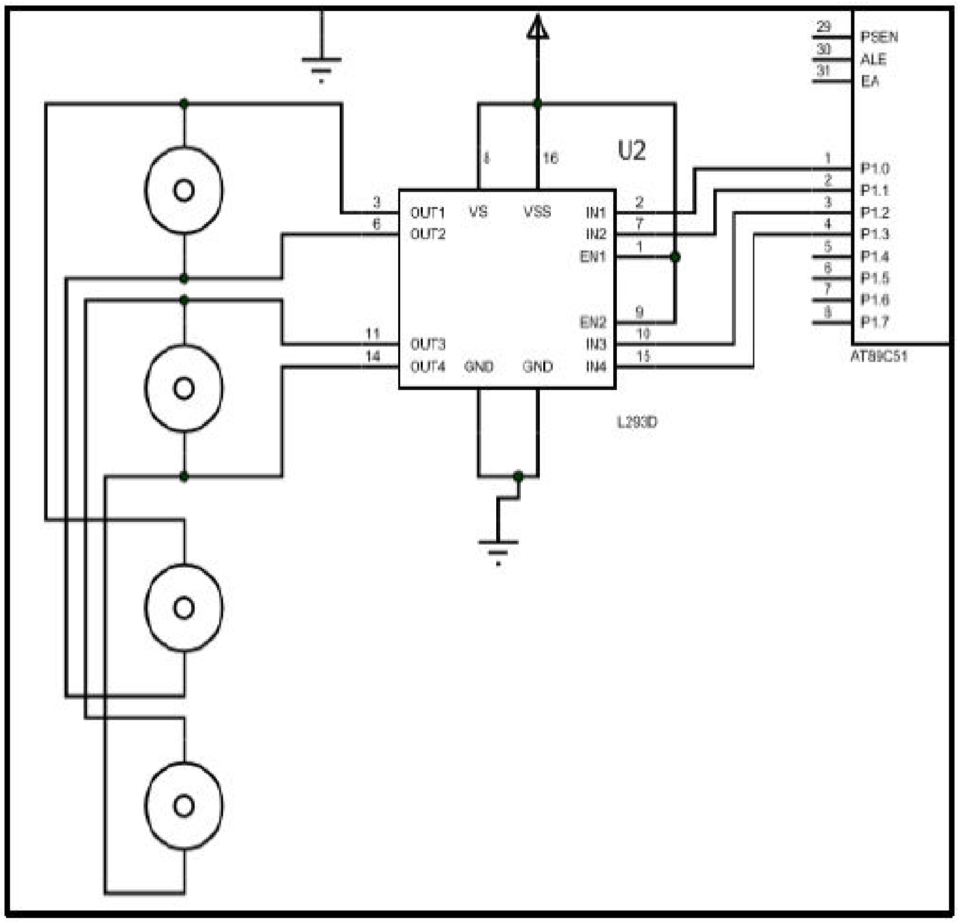
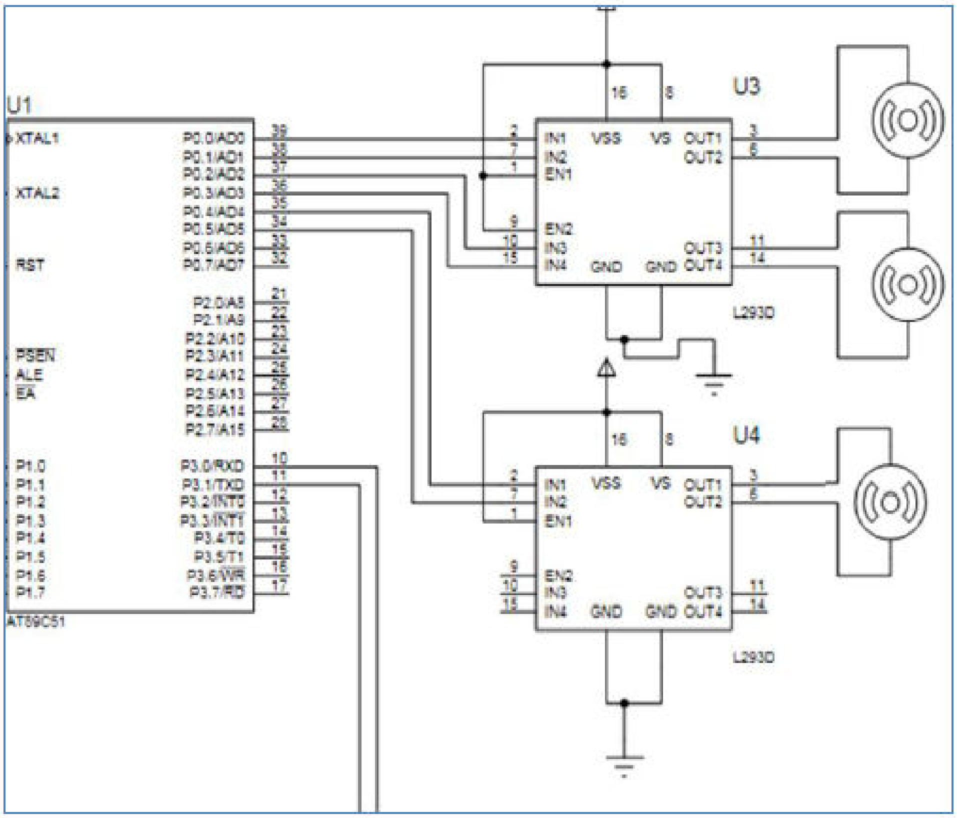


Wheel Drive Circuit Diagram



Grass Cutter Motor Circuit Diagram

Material and Specifications

Material	**Specification**
Motors for wheels	200 rpm and high torque
motors for cutter	High rpm
Motors	60 rpm,
Sprinkler Assembly	Compressed pump, plastic tank 1 lit, sprinkler
Wheels	20 cm
Chassis	Mild steel chassis
Cutter	2, 12 cm diameter
Seed sowing mechanism	nozzle type

Ploughing	Hydraulic/injection system/hydraulic system
Solar panel and charging assembly	12 v charging done in 2 days
RF transmitter and receiver	2.4 Gz 6 channel
general assembly	NA
microcontroller, wires	AVR controller
Patch cots and connector assembly	NA
Rack and pinion arrangement	Plastic
Battery (Receiver side)	12 v rechargeable
Cells (Transmitter side)	A +

Heat Treatment

The heat treatment for AISI 1018 mild/low carbon steel consists of the following processes:

Normalizing

AISI 1018 mild/low carbon steel should be heated at 890°C – 940°C and then cooled in still air.

Forging

This process requires heating between 1150°C – 1280°C and AISI 1018 mild/low carbon steel is held until the temperature becomes constant. 900°C is the minimum temperature required for the forging process.

The steel is then cooled in air after this process.

Tempering

AISI 1018 mild/low carbon steel is tempered at between 150°C – 200°C for improvement of case toughness. This process has little or no effect on hardness.

The occurrence of grinding cracks is reduced when AISI 1018 mild/low carbon steel is tempered at the above mentioned temperature.

Annealing

The AISI 1018 mild/low carbon steel is heated at 870°C – 910°C and allowed to cool in a furnace

Stress Relieving

500°C – 700°C is required to relieve stress in AISI 1018 mild/low carbon steel that is later cooled down in still air.

Case Hardening

This process requires heating to be carried out between 780°C – 820°C. AISI 1018 mild/low carbon steel is then quenched in water.

Core Refining

This is an optional process that requires heating at 880°C – 920°C.

AISI 1018 mild/low carbon steel after being heated is moistened in oil or water.

Carburizing

Carburizing takes place at 880°C – 920°C.

Applications of AISI 1018 MILD/LOW Carbon Steel

- It is used in bending, crimping and swaging processes.
- Carburized parts that include worms, gears, pins, dowels, non-critical components of tool and die sets, tool holders, pinions, machine parts, ratchets, dowels and chain pins use AISI 1018 mild/low carbon steel.
- It is widely used for fixtures, mounting plates and spacers.
- It is suitably used in applications that do not need high strength of alloy steels and high carbon.
- It provides high surface hardness and a soft core to parts that include worms, dogs, pins, liners, machinery parts, special bolts, ratchets, chain pins, oil tool slips, tie rods, anchor pins, studs etc.
- It is used to improve drilling, machining, threading and punching processes.
- It is used to prevent cracking in severe bends.

CALCULATIONS

Weight (W):- 20Kg

FOS =20% (for weight)

For maximum condition,

20+(20*20/100) = 24 Kg

Bot based on 4 wheels,

Therefore,

For 1 wheel thrust = 24/4 = 6 kg

FORCE= MASS* GRAVITY

F = m*g

F = 6*9.81 =58.86

F ≈ 60 N.

WORK = FORCE * DISTANCE

POWER = WORK/TIME

P = (force* distance)/time

P = force* velocity ... *(velocity =distance/time)*

Maximum speed of bot (assumed) = 10 km/hr

Velocity = 10*(5/18) = 2.77 m/s

Power = (60 N) * (2.77 m/s)

Power ≈ 166 watt

CURRENT RATING:

POWER = VOLTAGE * CURRENT

P = V * I

166 = 12 V * I

I = 166/12

I = 13.8 A.

* From above power and current rating we selected the **200 rpm** motor by referring standard specification of motor.

Conclusion

As per the reports from Stackyard, it is predicted that the global market of agricultural robots will be more than 10 billion dollars by year 2022. Such implementations of agribots make use of drones and robots for different activities of agriculture. The statistical analytics is predicting the revenue of $230m by year 2026. Assorted applications and areas are available for the agribots. In addition, to achieve the higher performance the use of machine learning algorithms can be integrated so that the overall optimization can be done. Workload on the farmers is decreased and health problems also. Successful in constructing robot which can be travelled on rough surfaces also and weighing enough load of compressor and other equipment. Successful in developing a robot whose construction is enough to withstand the challenges of the field. Sure about that once this concept will be presented in a manner suitable to Indian market, it will definitely help in bringing down the 15% molality rate found in the Indian formers associated with the agricultural applications like grass cutter, ploughing, seed sower, sprinkler. In future work, fully automatic with the help of advanced programming can be done with the aspects weight can be reduced by using another material.

References

[1] Ceres R, Pons JL, Jimenez AR, Martin JM, Calderón L. Agribot: A robot for aided fruit harvesting. Industrial Robot. 1998;25(5):337-46.

[2] Shivaprasad BS, Ravishankara MN. Design and implementation of seeding and fertilizing agriculture robot. International Journal of Application or Innovation in Engineering & Management (IJAIEM). 2014 Jun;3(6):251-5.

[3] Liu J, Li P, Li Z. A multi-sensory end-effector for spherical fruit harvesting robot. InAutomation and Logistics, 2007 IEEE International Conference on 2007 Aug 18 (pp. 258-262). IEEE.

[4] Roldán JJ, del Cerro J, Garzón-Ramos D, Garcia-Aunon P, Garzón M, de León J, Barrientos A. Robots in Agriculture: State of Art and Practical Experiences. InService Robots 2018.

[5] Pavan, T. V., R. Suresh, K. R. Prakash, and C. Mallikarjuna. "Design and Development of Agribot for Seeding." (2017)

[6] Sampoornam KP. An Agriculture Robot (AGRIBOT) for Harvesting Underground Plants (RHIZOMES). Agricultural Engineering International: CIGR Journal. 2017 Aug 18;19(2):62-7.

[7] Math RK, Dharwadkar NV. A wireless sensor network based low cost and energy efficient frame work for precision agriculture. InNascent Technologies in Engineering (ICNTE), 2017 International Conference on 2017 Jan 27 (pp. 1-6). IEEE.

[8] Khandelwal S, Kaushik N, Sharma S, Pandey MK, Rawat TS. AgRo-Bot: An Autonomous Robot. International Journal. 2017 May 15;8(5)

[9] Li P, Lee SH, Hsu HY. Review on fruit harvesting method for potential use of automatic fruit harvesting systems. Procedia Engineering. 2011 Jan 1;23:351-66.

[10] Gholap Dipak Dattatraya, More Vaibhav Mhatardev, Lokhande Manojkumar Shrihari3, . Joshi BE [E&TC], Vishwabharati Academy's College Of Engineering, Pune university, Ahmednagar, Maharashtra, India, Assistant Professor, Dept of E&TC, Vishwabharati Academy's College Of Engineering, Pune university, Ahmednagar, Maharashtra, India4 ;[Volume 3, Special Issue 4, April 2015]

[11] Swati D.Sambare, S.S.Belsare Dept. of Electronics BVDUCOEP Pune,India ; [Volume||3||Issue||5||Pages|| 2889-2892||2015|]

[12] P.Usha1,V.Maheswari2, Dr.V.Nandagopal3 1ME Student (Embedded System), Assitant Professor, 3Associate Professor, Department of Electrical and Electronics Engineering Ganadipathy Tulsi's Jain Engineering College, Vellore-632 102. ;[Volume No.1, Issue No.1. Page No: 138 -143, JULY – 2015]

[13] Amrita Sneha., Abirami., Ankita., Mrs.R.Praveena4, Mrs.R.Srimeena, Department of Electronics and Instrumentation Engineering Easwari Engineering College, Chennai, Tamil Nadu, India. 2015 IEEE International Conference on Technological Innovations in ICT for Agriculture and Rural Development (TIAR 2015), 978-1-4799-7758-1/15.